Lesson Plan - Derivatives

Kelly, KV, Lauren

Ministry Strand: Grade 12 Derivatives
Associate Teacher: N/A
Room #: N/A

Teacher Candidate: Kelly, KV, Lauren
Activity: Introduction to Derivatives
Time: 70 minutes

Specific Expectation
• 2.2 - Generate, through investigation using technology, a table of values showing the instantaneous rate of change of a polynomia function, f(x), for various of x, graph the ordered pairs, recognize that the graph represents a functions called the derivative, f'(x) or $\frac{dy}{dx}$, and make connections between the graph f(x) and f'(x) or y and $\frac{dy}{dx}$. • 2.4 - Determine the derivatives of polynomial functions by simplifying the algebraic expression $\frac{f(x+h)-f(x)}{h}$ and then taking the limit of the simplified expression as h approaches zero. (i.e. determining lim (h->0$\frac{f(x+h)-f(x)}{h}$).
Materials Needed
• Smart Board/Projector • Laptop • Student Textbook • Whiteboard • Dry Erase Markers • Exit Cards (Cue-cards)
Previous Homework
• N/A
Warm-Up Activity (20 minutes)

Discussion between applications of rates in the real-world *(*10 minutes)

- Start off with a driving example:
    - "Suppose I'm driving from Oshawa to Toronto. The distance is about 50 km and the speed limit is 100 km/hr. If I was driving at the speed limit the entire time, how long would it take to get there?"
    - "Is that ideal? What factors could change how long it takes me to get to Toronto?"
        - Weather, road conditions, traffic, some people like driving faster/slower, etc.
        - "At different points of the trip, we could have potentially gone faster or slower than 100km/hr. We could average out our speed to 100 km/hr, but our instantaneous speed at points of the trip could be different."

Group Work *(*10 minutes)

- Separate the class into pre-determined groups of a max of 4 students
- "In groups of 4, try to determine anything around you that are affected by rates. We will bring it in after 5 minutes and see all the examples we can get."
- Discussion and sharing ideas… We should have a lot.

Content (40 minutes)

Review of the Tangent Equation - from previous class (10 minutes)

- "Calculus is the mathematical study of *change*. All the examples we discussed about before, and then some, are all covered in Calculus. We know how to calculate average change from grade 9. But how about instantaneous? Using the slope equation (m= $\frac{\Delta y}{\Delta x}$) you already know, try to find the instantaneous slope of f(x) = x^2 at x = 1."
    - They should get division by zero which is not possible
    - "Since we can't actually divide by zero, we need to find another way."
        - Using this [app](app) create a secant between two points on a plot. Identify the relationship of the limit as the points get closer together, creating a tangent
        - Draw example of secant of f(x) = x^2 from x = 1 to x = 2, and drag the point at x = 2 down to x = 1.
        - "If we can drag this point as close as possible to x = 1 without actually reaching it, we can approximate its tangent. To get the exact value, we will have to use limits." (*Note:* The students will have learned limits earlier)

Defining a Derivative (10 minutes)

- The derivative is the value of the difference quotient as the secant lines approach the tangent line
- "This is the equation for finding the instantaneous rate of change (or tangent slope) of any function."
  - Be sure to draw the points x, x+h, f(x) and f(x+h) on a graph so they can see where the points come from
- "We call this the derivative of the function, denoted f'(x). We also denote it $\frac{dy}{dx}$; we use d delta instead of the triangle delta to represent the incredibly small difference, since we're using limits and are get closer and closer to x."
- "Why is the derivative of a function still a function?
  - On Board: The derivative of a function is a function.
  - Derivative of a function is a slope of a tangent line to the graph at any point on the graph

Example - completed as a class (20 minutes)

- **Example on finding the Slope of a Tangent (Derivative)**
  - Find the slope of a tangent line to the graph of f(x) 3x^2+2x at x = 1
  - Point out the f'(x) = 6x+2 is the general slope of the function at any point.
  - When students sub in x=1, this is the slope of the tangent at the point; the derivative.
- **The Existence of Derivatives**
  - Draw two graphs: A piecewise function and the absolute function.
    - Point out that you cannot differentiate a function at a discontinuity or at a corner.
    - On Board: If there is a vertical asymptote, a corner or discontinuity , there is no slope at the point.
- **Application of the Derivative - Related to Physics (Cross Curriculum)**
  - An object moves in a straight line with its position at time *t* seconds given by $s(t) = -t^2 + 8t$, where *s* is measured in metres. Find the velocity when t = 0, t = 4, and t = 6.
    - Things to point out:
      - V = S'(t) = $\frac{ds}{dt}$ is the derivative of position in terms of time. Velocity is a derivative of position.

Assessment and Evaluation (10 minutes)

Additional Practice (7 minutes)

- With your elbow partners find the derivative of f(x)= 3x^2+2x at x = 1
  - Note: students should acknowledge that finding the slope of a tangent and the derivative are one of the same

Consolidation (3 minutes)

- Quiz Master:
    - Each student is given a cue card and they are asked to write down two questions that if they were given these questions on a test they would be able to 100% on.
        - The questions must be related to today's lesson
        - These questions can include: definitions, theory, equations, solving derivatives
        - These questions can be short answer, multiple choice, true and false but they have to be difficult enough so that they can be added on a test

If there is extra time

Derivative Stations:

- Students are separated into 4-5 predetermined teams (this will give the students a chance to get out of their seats and work with other classmates)
- Teams will rotate clockwise to the next activity every ~5 minutes
- At each table there will be a cue card with a derivative question on it
- Students are expected to work with their team solve the question they are given at that station

Note: During the table work, this will give the teacher time to go from group to group to see if the students are having any difficulties with the problems.